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Operation Greenhouse
R.A. Meade

Operation Greenhouse Enewetak Atoll			
Test	Date	Shot Island	Yield (kt)
Dog	04/07/1951	Runit	81
Easy	04/20/1951	Engebi	47
George	05/08/1951	Engebi	225
Item	05/24/1951	Eberiru	45.5

As Edward Teller boarded a plane leaving Enewetak Atoll on May 9, 1951, he slipped a five-dollar bill to Ernest Lawrence. He had bet Lawrence that the George shot of Operation Greenhouse would not ignite its thermonuclear fuel – and lost. Payment of the gambling debt was, technically, a security violation. Teller was passing “*classified information in an unclassified area.*”¹ The more significant meaning of the bet was, as Los Alamos weapon engineer Jay Wechsler said, confirmation “*that our understanding of the means of initiating a small-scale thermonuclear reaction was adequate.*”²

The path to George began in the summer of 1942 when, during a small summer conference at Berkeley, Teller suggested the possibility of a super, or hydrogen, bomb. As Robert Serber recalled the scene, “*Everybody turned eagerly to discuss the super forgetting all about the atomic bomb as if that was an accomplished fact already.*”³ That eagerness quickly faded because even if an atomic bomb could ignite Deuterium, radiation cooling would quickly stop the thermonuclear reaction.

Despite this daunting technical complexity, which made the development of a thermonuclear unlikely during World War II, J. Robert Oppenheimer authorized thermonuclear research by a small group working under Teller’s direction. In early 1946, a conference organized by Norris Bradbury reviewed the wartime research, concluding that “*the super bomb can be constructed and will work.*”⁴ Shortly thereafter, the Laboratory’s Theoretical Division proposed a thermonuclear experiment as part of Operation Sandstone. This proposal, however, was tabled because of the need to proof test replacements for the wartime Fat Man device.

¹ Louis Rosen, *The Manhattan Project and Its Legacies*, LA-UR-09-03545.

² *Los Alamos Science, Winter/Summer 1983*, 159-163.

³ Robert Serber, Oral Interview.

⁴ Carson Mark, *LA-5467-MS*.

After Sandstone, attention turned once again to the possibility of conducting a thermonuclear experiment. Stan Ulam, John von Neumann, and even Hans Bethe were pessimistic. The stakes were high. *“Failure would mean a severe setback, perhaps even the abandonment of the quest for a thermonuclear bomb”*⁵ Enrico Fermi, a bit more optimistic argued that , *“A test should have a probability of failure to be a good one.”*⁶ When Bethe ultimately changed his mind and argued for inclusion of a thermonuclear experiment, George became one of the four planned Greenhouse tests.⁷ The fact that President Truman had, early in 1950, put a priority on developing the hydrogen bomb helped matters along.

Formal planning for Operation Greenhouse began in 1949 with the creation of Joint Task Force 3 commanded by Lieutenant General E. R. Quesada. As was the case with both Crossroads and Sandstone, a military task force provided the command structure and security for the tests, the overseas movement of 285,000 tons of supplies to a base 4500 miles from the mainland, and the construction, operating and technical units.⁸ However, when North Korea invaded and came close to overrunning South Korea in June 1950, the Joint Chiefs of Staff nearly cancelled Greenhouse. The military resources necessary for the defense of South Korea were the same resources required by JTF-3. Norris Bradbury intervened, telling Brigadier General James McCormack, Director of the AEC’s Division of Military Application, that Greenhouse was necessary, coming *“precisely at a time in international relations, when the most rapid progress should be made in this field.”*⁹

Alvin Graves, Scientific Director for Greenhouse, named the Greenhouse tests Dog, Easy, George, and Item. Dog and Easy were vastly improved implosion devices providing gains in efficiency far in excess of the Sandstone devices. At 81 kilotons, Dog, the largest yield fission device to date, greatly increased the destructive potential of the United States stockpile. The George shot verified the ability to achieve a thermonuclear reaction, leading directly to the Mike shot a little over a year later.¹⁰ The fourth and final test, Item, is particularly noteworthy because it proved the principle of boosting,” the technique “of using a fission bomb to initiate a small thermonuclear reaction that increases the efficiency of the use of the fissile material.”¹¹ Boosting is, perhaps, the most underappreciated technical achievement related to the development of the hydrogen bomb.¹²

⁵ Hewlett, 539-540.

⁶ Ibid, 530.

⁷ Richard G. Hewlett and Francis Duncan, *Atomic Shield: A History of the United States Atomic Energy Commission, Volume II, 1947-1952* (Berkeley, University of California Press, 1990), 543-544.

⁸ Statements at Press Conference on Operation Greenhouse, 20 June 1951. Comment made by General Quesada.

⁹ N. E. Bradbury to McCormack, LANL Archives, 22 August 1950.

¹⁰ Atomic Energy Commission, *Draft Report to the President on the Status of Thermonuclear Program*, LANL Archives, February 26, 1951.

¹¹ Herbert York, *The Advisors*, 23 and Carson Mark, *“A Short Account”*, 9.

¹² See Hans Bethe, “Comments on the History of the H-Bomb”, *Los Alamos Science*, Fall, 1982, for Bethe’s overall assessment of the early hydrogen bomb program.

In a June 13, 1951, press conference, Graves summarized the Greenhouse tests, particularly the George shot, saying, "Most of the thermonuclear research was so novel and complex that we would have been happy if only a few of them had worked. It I a remarkable tribute to the laboratories and the other agencies that participated in this work that so much useful information was secured from these projects."¹³

¹³ Statements at Press Conference on Operation Greenhouse, Washington D.C., June 13, 1951.